

SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE



Prevalence of Hyperglycemia and Degree of Glycemic Control in Patients Admitted to St. Paul's Hospital Millennium Medical College Adult Intensive Care Unit

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August, 2019

Addis Ababa, Ethiopia

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Care Unit**

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Acronyms and Abbreviations

ADA – American Diabetes Association

BG – Blood Glucose

DKA – Diabetic Ketoacidosis

HgA1C – Hemoglobin A1C

ICU – Intensive Care Unit

IV – Intravenous

POC-BG – Point of Care Blood Glucose

SC – Subcutaneous

SPHMMC – Saint Paul’s Hospital Millennium Medical College

SPSS - Statistical Package for the Social Science

ABSTRACT

Background: Hyperglycemia in hospitalized patients is defined as blood glucose levels >140mg/dl (7.8mmol/L). Hyperglycemia in hospitalized patients is associated with poor outcomes including prolonged hospital stay, infection, disability after discharge from hospital and death. Treatment of inpatient hyperglycemia results in reduced morbidity and mortality.

Objective: The aim of the study is to assess the prevalence of hyperglycemia and degree of glycemic control in patients admitted to St. Paul's Hospital Millennium Medical College, adult intensive care unit.

Method: A cross sectional descriptive study was done by review of 113 medical records of patients admitted to St. Paul's Hospital Millennium Medical College, adult intensive care unit from January 2014 up to December 2018. Data was collected using a checklist which was developed by using information gathered from other studies. Data was analyzed using SPSS version 25. Descriptive analysis was done to describe baseline characteristics of study population, pattern of hyperglycemia and degree of glycemic control.

Results: Of the 113 patients' majority were female (65.5%) and mean age was 36.4 (± 17.8) years. Medical diagnosis was the main reason for admission. Prevalence of hyperglycemia was 47.8% during ICU stay. Percentage of blood glucose level in the target optimal range (140-180mg/dl) was 31.1% in those who had hyperglycemia during ICU stay. HbA1c test was done only for 1 patient from those who had hyperglycemia. Majority of patients (60%) were treated using subcutaneous insulin.

Conclusion: Prevalence of hyperglycemia is high in ICU patients. Of the patients with hyperglycemia proportion of blood glucose level in target range was low.

Key Words: hyperglycemia, intensive care unit, glycemic control

1.INTRODUCTION

1.1 Background

Hyperglycemia occurs in patients with known or undiagnosed diabetes, or it occurs during acute illness in those with previously normal glucose tolerance (termed “stress hyperglycemia”). [1] Hyperglycemia in hospitalized patients is defined as blood glucose (BG) levels $>140\text{mg/dl}$ (7.8mmol/L). [2]

The exact prevalence of hyperglycemia in hospitalized patients is not known. The prevalence ranges from 7.9% up to 89% in different studies. [4-14] This variation is due to the different definition used for hyperglycemia, the different study populations and hospital setup.

Hyperglycemia is common in critically ill patients. Factors contributing to hyperglycemia include release of stress hormones (e.g. epinephrine and cortisol), the use of medications such as corticosteroids and vasopressors, release of inflammatory mediators, and the use of densely caloric enteral and parenteral nutritional supplements. All of these mechanisms lead to insulin resistance, absolute or relative insulin deficiency and impaired glucose metabolism. [3]

Studies have shown that the presence of hyperglycemia is associated with increased morbidity, mortality and prolonged hospital stay in different groups of patients (acute myocardial infarction, stroke, pneumonia, chronic obstructive pulmonary disease, and trauma). [3,4,12,13,15-23]

The American Diabetes Association (ADA) recommends to perform HgA1C (Hemoglobin A1C) test on all patients with diabetes or hyperglycemia admitted to the hospital if the test has not been performed in the prior 3 months. HgA1C test will help identify long-standing versus new hyperglycemia, as well as guiding decision regarding inpatient insulin management. An admission HbA1C value $\geq 6.5\%$ suggests that diabetes preceded hospitalization. [2]

Blood glucose levels that are persistently above 140mg/dl may require alteration in diet or a change in medication that cause hyperglycemia. Insulin therapy should be initiated for treatment of persistent hyperglycemia starting at a threshold $\geq 180\text{mg/dl}$. [2]

Once insulin therapy is started, a target glucose range of $140\text{--}180\text{mg/dl}$ is recommended for the majority of critically ill and non-critically ill patients. More stringent goals, such as 110--

140mg/dl, may be appropriate for selected patients, as long as this can be achieved without significant hypoglycemia. Conversely, higher glucose ranges may be acceptable in terminally ill patients, in patients with severe comorbidities, and in inpatient care settings where frequent glucose monitoring or close nursing supervision is not feasible. [2]

In the critical care setting, continuous intravenous insulin infusion has been shown to be the best method for achieving glycemic targets. Intravenous insulin infusion should be administered based on validated written or computerized protocols that allow for predefined adjustments in the infusion rate, accounting for glycemic fluctuation and insulin dose. [2]

Outside of critical care unit, Subcutaneous (SC) administration of insulin is used much more frequently. Orally administered agents have a limited role in the inpatient setting. [2]

Several methods have been proposed for determining the adequacy of glycemic control across a hospital or unit. A simple measure of mean blood glucose provides information similar to that from more complex metrics (hyperglycemic index, time-averaged glucose). The “patient-day” unit of measure is another proposed metric of hospital glucose data, especially when there is substantial variability in the duration of hospital stay. The patient-day metric may yield a more accurate assessment of the frequency of hypoglycemia and severe hyperglycemic events, providing an approach for obtaining measures of performance for clinical investigation. [1]

1.2 Statement of the problem

The exact prevalence of hospital hyperglycemia is not known. Prevalence of inpatient hyperglycemia varies in different studies. Hyperglycemia is associated with increased morbidity and mortality.

Much emphasis is given when hospitalized patients develop hypoglycemia rather than hyperglycemia. Mostly it is taken as part of the clinical course of the illness and attention is not given and management is also not initiated properly.

Treatment of inpatient hyperglycemia results in reduced morbidity and mortality. It is also important to evaluate the glycemic control of patients with known diabetes during hospitalization

so that important management strategies be applied if poor glycemic control is present. Identifying hyperglycemia in hospitalized patients will help make diagnosis of unknown diabetes and also identify those at risk of developing diabetes in the future.

Established protocols to control inpatient hyperglycemia should be implemented to reduce the risks associated with inpatient hyperglycemia.

1.3 Significance of the study

This study will provide information about the prevalence of hyperglycemia in patients hospitalized at St. Paul's Hospital Millennium Medical College (SPHMMC) adult intensive care unit (ICU) and also will assess the degree of glycemic control.

The finding of the study will also be used as base for conducted further studies.

2. LITERATURE REVIEW

In-hospital hyperglycemia is common in hospitalized patients, especially in critically ill, and it is associated with increased hospital stay, adverse effects and increased morbidity and mortality.

In a study conducted by Umpierrez GE et.al, medical records of 1,886 adult patients admitted to Georgia Baptist Medical Center, a community teaching hospital in downtown Atlanta, GA, from July 1, 1998, to October 20, 1998 was reviewed. New hyperglycemia was defined as an admission or in-hospital fasting glucose level of 126mg/dl or more or a random blood glucose level of 200mg/dl or more on 2 or more determinations. Hyperglycemia was present in 38% of patients admitted to the hospital, of whom 26% had a known history of diabetes, and 12% had no history of diabetes before the admission. Patients with new hyperglycemia were more likely to be admitted to the ICU and had a longer length of hospital stay compared with patients with a prior diagnosis of diabetes and normoglycemic subjects. Newly discovered hyperglycemia was associated with higher in-hospital mortality rate compared with those patients with a prior history of diabetes and subjects with normoglycemic. [4]

In a prospective study done in a tertiary-care teaching hospital in U.S (Washington, DC), medical records of 1,034 consecutively hospitalized adult patients was evaluated. Of the 1,034 hospitalized adult patients, 130 (12.6%) had one or more documented plasma glucose values >200mg/dl. one-third of all hyperglycemic patients on both the medical and surgical services had no prior history of diabetes. [5]

In a retrospective cohort study conducted at a tertiary university hospital in Latin America to estimate the prevalence of people with diabetes, prevalence of hospital hyperglycemia and incidence of stress hyperglycemia in hospitalized patients evaluated the medical records of 21,397 patients. Hospital hyperglycemia was defined as any plasma glucose >140mg/dl during hospitalization. The prevalence of hospital hyperglycemia in this study was 40.40%. In this study, 20% of the population were attended in the ICU and hospital hyperglycemia in these group was 46.1%. [6]

In a study where 111 hospitals in Spain participated, a total of 5439 hospitalized patients were surveyed and 1000 (18.4%) had hyperglycemia or known diabetes. Hyperglycemia was defined as an admission or in-hospital fasting blood glucose level $\geq$ 140mg/dl or a random blood glucose

level of $\geq 200\text{mg/dl}$ on 2 or more determinations. The overall proportion of glucose values within the target established as optimum ($70\text{-}180\text{mg/dl}$) varied from 47% at bedtime to 79.5% before breakfast. [7]

A study done in US evaluated inpatient point-of-care bedside glucose (POC-BG) tests from 575 hospitals from January 2009 to December 2009. A total of 49,191,313 POC-BG measurements (12,176,299 ICU; 37,015,014 non-ICU) were obtained from 3,484,795 patients (653,359 ICU; 2,831,436 non-ICU). The prevalence of hyperglycemia ($> 180\text{mg/dl}$) was 32.2% in ICU patients and 32.0% in non-ICU patients. [8]

Another similar study was done in U.S including 635 hospitals reviewed POC-BG tests from January to December 2012. In total 51,375,764 POC-BG measurements (non-ICU, 2,415,209; ICU, 575,084) were analyzed. The prevalence of hyperglycemia (defined as glucose value $>180\text{mg/dl}$) was 32.3 and 28.2% in non-ICU and ICU respectively. [9]

In a study done in U.S on Impact of admission hyperglycemia on hospital mortality in various intensive care unit populations which included 2713 patients who were admitted to ICUs found that 27.4% of the patients had hyperglycemia, as defined by admission glucose 200mg/dl . Among those with admission hyperglycemia, 10.4% died, compared with 8.0% of those without hyperglycemia. [10]

A cross-sectional survey was conducted in Brazil including a total of 2,399 patients from 24 hospitals. The prevalence of any hyperglycemic (Blood Glucose $>180\text{mg/dl}$) event was 89.4% of patients in general wards and 88.2% in those in ICUs. A relatively high proportion of patients were treated with sliding-scale insulin regimen alone in the general wards (55.2%) and in the ICUs (61.2%). Only 35.7% and 3.9% received appropriate insulin therapy in general wards and in ICUs, respectively. Overall, the percentage of patient-days with blood glucose (BG) values within a predefined “optimal” range ($80\text{-}139\text{mg/dl}$) was only 11.8% in general wards and 15.0% in ICUs. [11]

A study which included 3184 patients who underwent inpatient non-cardiac surgical procedures at Emory University Hospital, a tertiary academic center in Atlanta, Georgia found clinically significant hyperglycemia (defined as a BG $>180\text{ mg/dl}$) was observed in 7.9% of patients before

surgery, 17.2% of subjects on day of surgery, and in 9.9% of patients during the postoperative period (days 2-10). [12]

In a study done in Sarajevo, Bosnia and Herzegovina which included 100 patients hospitalized in Medical intensive care unit in the period January 2014–March 2015, the overall prevalence of patients with hyperglycemia (BG level >200mg/dl) was 54% (35% with diabetes mellitus and 19% with a stress hyperglycemia). Patients with stress-hyperglycemia had higher mortality (52.6%) compared to patients with previously diagnosed diabetes (48.6%) or normoglycemia (36.9%). [13]

In a study done in India which included 536 non-diabetic patients admitted to medical ICU found prevalence of stress hyperglycemia (BG >140mg/dl) of 20.33%. [14]

3. OBJECTIVE

3.1 General Objective

- To assess prevalence of hyperglycemia and degree of glycemic control in patients admitted to SPHMMC adult ICU from January 2014 to December 2018.

3.2 Specific Objectives

- To assess prevalence of hyperglycemia in patients admitted to SPHMMC adult ICU from January 2014 to December 2018.
- To assess degree of glycemic control in patients admitted to SPHMMC adult ICU from January 2014 to December 2018.

4. METHODOLOGY

4.1 Study area and period

The study was conducted in St. Paul's Hospital Millennium Medical College. SPHMMC is one of the largest tertiary referral public hospitals in the capital under the Federal Ministry of Health. The hospital is located at Gullele Sub city at Swaziland Street, Addis Ababa, Ethiopia. It was established by Emperor Haile Selassie in 1961. The hospital gives service under different units including internal medicine, pediatrics, gynecology/obstetrics, surgery, public health, dentistry, psychiatry, ophthalmology, hospital pharmacy, dermatology, ENT and Maxillo-facial.

There are 6 beds in SPHMMC adult ICU and gives service to internal medicine, surgery and OBGYN patients.

The study was conducted at SPHMMC by review of patient's data admitted to adult ICU from January to 2014 to December 2018. Study was conducted (data collection & analysis) from June 2019 up to August 2019.

4.2 Study design

A cross-sectional descriptive study done by review of medical records of patients admitted to SPHMMC adult ICU from January 2014 up to December 2018 was done.

4.3 Population

4.3.1 Source population

All Patients admitted to SPHMMC adult ICU from January 2014 up to December 2018.

4.3.2 Study population

Patients admitted to SPHMMC adult ICU from January 2014 up to December 2018 and who meet the inclusion criteria.

4.4 Inclusion and exclusion criteria

4.4.1 Inclusion criteria

- Patients who stayed for ≥ 24 hrs.

4.4.2 Exclusion criteria

- Patients with hyperglycemia on presentation
- Patients with DKA (diabetic ketoacidosis) and HHS (hyperosmolar hyperglycemic state)
- Pregnant women

4.5 Sample size determination and sampling technique

4.5.1 Sample size determination

The sample size for the study was determined using

$$n = \frac{(Z\alpha/2)^2 P(1-p)}{d^2}$$

Where: n = required sample size

$Z \alpha/2$ = Critical value = 1.961.

p = 50%. P is estimated prevalence of inpatient hyperglycemia. P is taken as 50% since there were no similar studies published in our country as to the knowledge of the investigator.

d = precision (marginal error) = 0.05

$$\text{Therefore: } n = \frac{(1.96)^2 (0.5 \times 0.50)}{(0.05)^2} = 384$$

Since the study population is less than 10,000 the final sample size will be

$$nf = \frac{n}{[1 + n/N]}$$

$$nf = \frac{384}{[1 + 384/1125]} = 286$$

→ nf- Final sample size; N- number of patients admitted to ICU over five-year period.

Non response rate of 10% was taken and added to the above calculated sample size. The final sample size was 315.

Even if the calculated sample size was 315, only 113 patients had documented blood glucose measurements and were found to meet the inclusion criteria

4.5.2 Sampling technique

All patients who meet the criteria were included in the study.

4.6 Study variables

4.6.1 Independent variables

- Age
- Sex
- Admission diagnosis
- Previous history of DM
- Renal impairment
- Dialysis
- Medications administered

4.6.2 Dependent variables

- Hyperglycemia (Yes Vs No)
- Degree of glycemic control (Optimal Vs Non-optimal)

4.7 Operational definition

- Hyperglycemia is defined as any BG value > 140mg/dl (7.8mmol/l) [2]
- Degree of glycemic control [2]
 - Optimal –mean daily blood glucose level in the range of 140-180mg/dl
 - Not optimal – mean daily blood glucose level not in the optimal range

4.8 Data collection tool and procedures

Data was collected from patient medical record using a checklist which was developed by using information from studies (3,4,6,10,13) and adopting to the research significance in this study.

Information about patient's age, sex, admission diagnosis, history of diabetes, presence of renal impairment and dialysis, blood glucose level on admission and during ICU stay, HbA1C level, length of hospital stay, use of medication associated with hyperglycemia, treatment of hyperglycemia and patient outcome was obtained. Data was collected by interns who were oriented and supervised by a resident.

4.9 Data quality assurance

By taking 5%, pretest was done using 16 patient data prior to data collection to assess for clarity of check list and appropriate corrections were made. Those taken for pretest were not included in the study. During initial data collection the principal investigator supervised data collection procedure to assist if there were any difficulty and to make sure data collection was proper. Collected data was checked on daily basis by the principal investigator for completeness.

4.10 Data processing and analysis

Data was entered in to a computer using SPSS (Statistical Package for the Social Science) version 25 after it was cleaned and coded. Descriptive analysis was done to describe baseline characteristics of study population, pattern of hyperglycemia and degree of glycemic control. Results were presented using frequency tables and graphs. Age, blood glucose level and length of stay were described using range, minimum, maximum and mean.

4.11 Ethical consideration

Ethical clearance and permission letter was obtained from the Institutional Review Board (IRB) of SPHMMC. A formal letter was written by the Medical Service Vice Provost Office of the Hospital and Department of Internal medicine to the concerned units. Names and other identification that will reveal patients' identity were not included in the checklist. Information obtained from patients' medical record were handled with confidentiality and were not used for any other purpose than the study.

4.12 Dissemination of results

The result of the study will be presented to all concerned bodies and will also be published in accessible local or international journals.

5. RESULTS

A total of 1125 patients were admitted to the adult ICU of SPHMMC from January 2014 to December 2018. All those who meet the criteria were included. A total of 113 patients' medical records were reviewed.

5.1 Baseline clinical characteristics

Out of the 113 study population, 74 (65.5%) were female and 59 (52.2%) of the patients were in the age range of 25-54 years. The mean age of the population was 36.4 (± 17.3) years. One hundred and two (90.3%) patients were admitted primarily with medical diagnosis and from this the common reason for admission was respiratory disease 51 (45.1%). Surgical diagnosis accounted for 9.7%. Out of the 113, 8 (7.1%) were diagnosed to have diabetes prior to admission. Renal impairment was present in 42 (37.2%) patients and 15 (13.3%) patients were on dialysis. The mean duration of ICU stay was 5.96 days (± 5.58), minimum and maximum duration of stay were 2 and 37 days respectively. Sixty (53.1%) patients didn't receive any medication causing hyperglycemia. Assessing outcome of patients, 58 (51.3%) patients were discharged improved.

Baseline characteristics of study participants is shown in Table 1.

Table 1: Baseline characteristics of study participant (n=113) in SPHMMC ICU, 2014-2018

Variable	Category	Frequency	Percentage
Age (years)	15-24	30	26.5%
	25-54	59	52.2%
	55-64	12	10.6%
	≥ 65	12	10.6%

Sex	Male	39	34.5%
	Female	74	65.5%
Admission diagnosis	Medical	102	90.3%
	Cardiovascular	18	15.9%
	Respiratory	51	45.1%
	Gastrointestinal	2	1.8%
	Renal	4	3.5%
	Neurology	10	8.8%
	Sepsis/septic shock	13	11.5%
	Poisoning	4	3.5%
	surgical	11	9.7%
	General	8	7.1%
	Trauma	3	2.7%
History of diabetes	Yes	8	7.1%
	No	105	92.9%
Renal impairment	Yes	42	37.2%
	No	71	62.8%
On dialysis	Yes	15	13.3%
	No	98	86.7%
Medication given	Corticosteroid	18	15.9%

causing hyperglycemia	Vasopressor	12	10.6%
	Glucose containing IV fluids	1	0.9%
	Corticosteroid and vasopressor	22	19.5%
	None	60	53.1%
Outcome	Discharged	58	51.3%
	Died	54	47.8%
	Transferred to another hospital	1	0.9%

5.2 Prevalence of hyperglycemia and degree of glycemic control

From the 113 study participant, hyperglycemia (BG level >140mg/dl) was present in 54 (47.8%) patients during ICU stay. Mean BG level for each patient day was calculated to assess degree of glycemic control for those who had hyperglycemia.

A total of 341 daily mean BG levels were obtained from the 54 study participants who had hyperglycemia during ICU stay. From the pooled 341 daily mean BG levels, 31.1% were in the target range (140-180mg/dl).

Prevalence of hyperglycemia and degree of glycemic control is shown in figure 1 and figure 2 respectively.

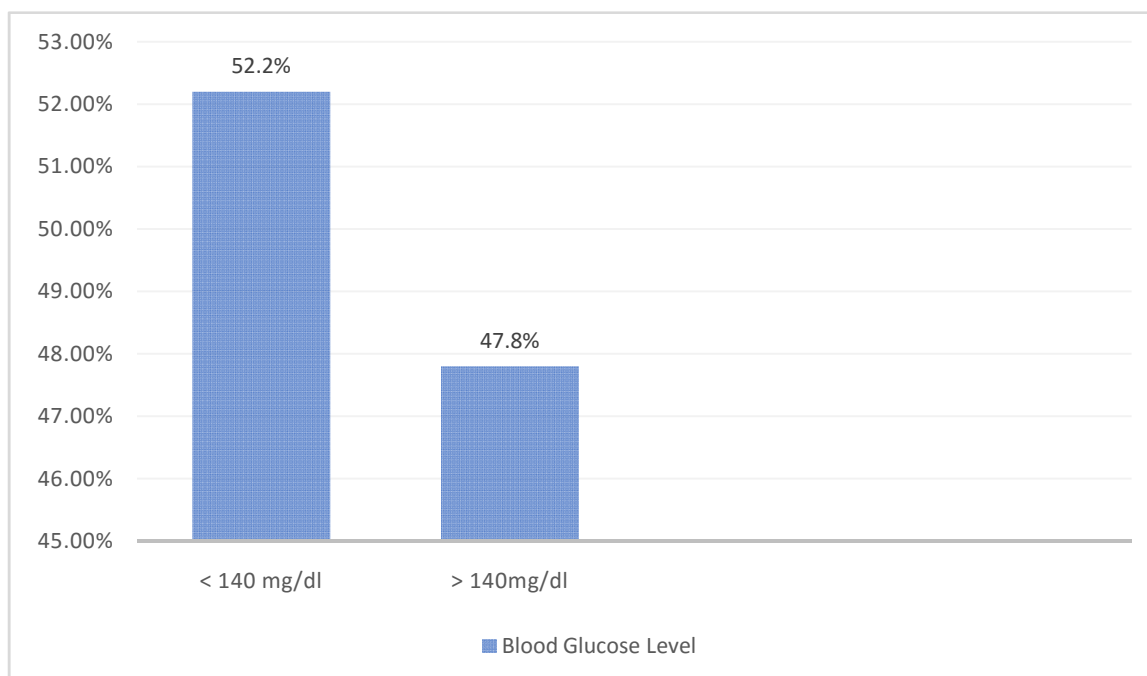


Figure 1: prevalence of hyperglycemia in study participant, SPHMMC ICU from 2014 to 2018

HgA1C level was determined only for 1 (1.9%) patient out of the 54 study population who had hyperglycemia during ICU stay.

During ICU stay, 20 patients had records of BG ≥ 180 mg/dl and SC insulin was used for treatment of hyperglycemia of ≥ 180 mg/dl in 12 (60%) patients.

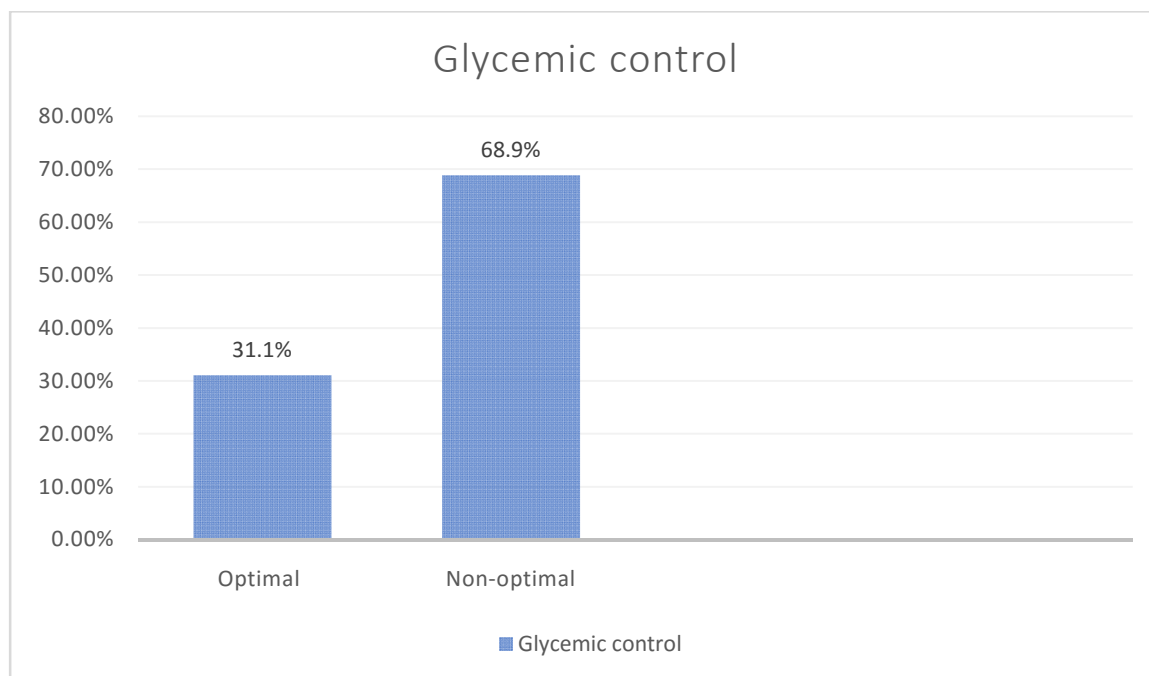


Figure 2: Degree of glycemic control, SPHMMC ICU 2014-2018

Table 2: Treatment given for hyperglycemia of BG level $\geq 180\text{mg/dl}$ (n=20), SPHMMC ICU from 2014 to 2018

Variable	Category	Frequency	Percentage
Treatment given for hyperglycemia	IV insulin	1	5%
	SC insulin	12	60%
	None	7	35%

6. DISSCUSION

The prevalence of hyperglycemia in this study was 47.8% which is higher than the one done by Sharma Jitendra et al, which was 20.3%. [14] Possible reason for this could be, in the study done by Sharma Jitendra et al, the patients were not very sick and may make the prevalence low. Other possibilities could be diabetic patients were included in this study which can make the prevalence higher.

Of the patients who had hyperglycemia (BG level > 140mg/dl), the percentage of blood glucose levels in the target range (140-180mg/dl) was 31.1%. Even though there is no absolute definition of high quality BG control, the American Association of Clinical Endocrinology and the ADA suggested in their consensus statement on inpatient glycemic control in 2009, that institutions should aim for the highest percentage of patients with a pre-specified BG target range. The low percentage of the proportion of BG level in the target range in this study could be due to lack of knowledge of health professionals on importance and treatment of hyperglycemia, lack of resources and unavailability of hyperglycemia treatment protocol in the institution

The ADA guideline for diabetes care 2019 recommends performing HgA1C test for hospitalized patients with hyperglycemia and for those with diabetes if this test hasn't been done in the previous 3 months. In this study, HgA1C test was done only for one patient from those who had hyperglycemia during ICU stay. This finding suggest that opportunities were missed to detect undiagnosed diabetes in those with hyperglycemia.

The ADA recommends treating persistent hyperglycemia starting at a threshold ≥ 180 mg/dl using continuous insulin infusion with the target of maintaining BG level in the range of 140-180mg/dl. In this study, there were no patients treated with continuous insulin infusion and only one patient was treated with intermittent IV insulin. Majority was treated with SC insulin and 35% of patients who had persistent BG level ≥ 180 mg/dl didn't even receive any medication for treatment of hyperglycemia. This finding shows that management of hyperglycemia was not based on standard guideline recommendation.

7. LIMITATION OF THE STUDY

The sample size was small due to lack of documentation of blood glucose measurement on patient medical record and missed patients' charts. Since the study was retrospective, data used were secondary which may lead to missed information due to incomplete documentation.

8. CONCLUSION

The finding of this study showed that prevalence of hyperglycemia is high and Percentage of blood glucose levels in the optimal target range was low (31.1%). HgA1C testing was also found to be low in patients with hyperglycemia and treatment of hyperglycemia was not based on guideline recommendations.

9. RECOMMENDATION

Based on this study the recommendations forwarded include:

- Health professionals should have a high index of suspicion of hyperglycemia in hospitalized patients and should be aware of its proper management.
- The intensive care unit (all health professionals) should work to achieve possible highest percentage of blood glucose level in the optimal range for patients during ICU stay.
- Further studies should assess glycemic control in the general medical ward and other departments
- Further studies should also assess reasons for low percentage of blood glucose levels in the ICU
- Proper documentation and handling of patients medical records should be done at all levels responsible for documentation and handling of patient data in the hospital.

10. REFERENCE

1. Moghissi ES, Korytkowski MT, DiNardo M, Einhorn D, Hellman R, Hirsch IB, et al.; American Association of Clinical Endocrinologists and American Diabetes Association consensus statement on inpatient glycemic control. *Diabetes Care* 2009; 32:1119-1131.
2. American Diabetes Association: Standards of medical care in diabetes. *Diabetes Care* 2019 Jan; 42suppl 1.
3. Krinsley JS. Association between hyperglycemia and increased hospital mortality in a heterogeneous population of critically ill patients. *Mayo Clin Proc.* 2003 Dec; 78(12):1471-1478.
4. Umpierrez GE, Isaacs SD, Bazargan N, You X, Thaler LM and Kitabchi AE; Hyperglycemia: An Independent Marker of In-hospital Mortality in Patients with Undiagnosed Diabetes. *The Journal of Clinical Endocrinology & Metabolism* 2002; 87:978–982.
5. Levetan CS, Passaro M, Jablonski K, Kass M and Ratner RE; Unrecognized Diabetes Among Hospitalized Patients. *Diabetes Care.* 1998; 21(2):246–249.
6. Russo MP, Elizondo CM, Giunta DH and Ratti MF; Prevalence of hyperglycemia and incidence of stress hyperglycemia in hospitalized patients: A retrospective cohort. *European Journal of Internal Medicine* 2017.
7. Ena J, Gómez-Huelgas R, Romero-Sánchez M, Gaviria AZ, Calzada-Valle A, Varela-Aguilar JM, et al.; Hyperglycemia management in patients admitted to internal medicine in Spain: A point-prevalence survey examining adequacy of glycemic control and guideline adherence. *Eur J Intern Med* 2015.
8. Swanson CM, Cook CB, Potter DJ and Kongable GL: An Update on Inpatient Glycemic Control in Hospitals in the U.S. *Hospitals. EndocrPract* 2011; 17:853–861.
9. Bersoux S, Cook CB, Kongable GL, Shu J, Zito BR: Benchmarking glycemic control in U.S hospitals. *Endocr Pract.*2014; 20:876-883.
10. Whitcomb BW, Pradhan EK, Pittas AG, Roghmann MC, Perencevich EN: Impact of admission hyperglycemia on hospital mortality in various intensive care unit populations. *Critical Care Medicine* 2005; 33:2772-2777.
11. Moreira et al: Glycemic control and diabetes management in hospitalized patients in Brazil. *Diabetology& Metabolic Syndrome* 2013 5:62.

12. Frisch A, Chandra P, Smiley D, Hudson M, Mendoza J, Johnson R, et al.; Prevalence and clinical outcome of hyperglycemia in the perioperative period in noncardiac surgery. *Diabetes Care* 2010; 33(8):1783–1788.
13. Godinjak A, Iglica A, Burekovic A, Jusufovic S, Ajanovic A, Tancica, Kukuljac A; Hyperglycemia in critically ill patients: Management and prognosis. *Med Arh.* 2015 Jun; 69(3): 157-160.
14. Sharma J, Chittawar S, Maniram RS, Dubey TN and Singh A: Clinical and epidemiological study of stress hyperglycemia among medical intensive care unit patients in central India. *Indian J Endocrinol and Metab.* 2017; 21(1):137-141.
15. Standers I, Diamant M, Van Gelder RE, Spruijt HJ, Twisk JR, Heine RJ, et al.: Admission blood glucose level as risk indicator of death after myocardial infarction in patients with and without diabetes mellitus. *Arch Intern Med.* 2004; 164:982-988.
16. Kosiborod M, Inzucchi SE, Spertus JA, Wang Y, Masoudi FA, Havranek EP, et al.: Elevated admission blood glucose and mortality in elderly patients with heart failure. *Circulation.* 2009; 119:1899-1907.
17. Capes SE, Hunt D, Malmberg K, Pathak P and Gerstein HC: Stress hyperglycemia and prognosis of stroke in non-diabetic and diabetic patients: a systemic overview. *Stroke.* 2001; 32:2426-2432.
18. Stead LA, Gilmore RM, Bellolio MF, Mishra S, Bhagra A and Vaidyanathan L: Hyperglycemia as an independent predictor of worse outcome in non-diabetic patients with acute ischemic stroke. *Neurocrit Care* 2009; 10:181-186.
19. McAlister FA, Majumder SR, Blitz S, Rowe BH, Romney J and Marrie TJ: The relation between hyperglycemia and outcomes in 2,471 patients admitted to the hospital with community-acquired pneumonia. *Diabetes Care* 2005; 28: 810-815.
20. Baker EH, Janaway CH, Philips BJ, Brennan AL, Baines DL, Wood DM and Jones PW: Hyperglycemia is associated with poor outcome in patients admitted to the hospital with acute exacerbation of chronic obstructive pulmonary disease. *Thorax* 2006; 61:284-289.
21. Faleiglia M, Freyberg RW, Almenoff PL, D'Alessio DA and Render ML: Hyperglycemia-related mortality in critically ill patients varies with admission diagnosis. *Crit Care Med* 2009; 37(12): 3001-3009.

- 22.** Yendamuri S, Fulda GJ and Tinkoff GH: Admission hyperglycemia as a prognostic indicator in trauma. J Trauma 2003; 55:33-38.
- 23.** Sung J, Bochicchio GV, Joshi M, Bochiccio K, Tracy K and Scalea TM: Admission hyperglycemia is predictive of outcome in critically ill trauma patients. J Trauma 2005; 59:80-83.

11. ANNEX

ANNEX I - DATA COLLECTION FORMAT

Date: -

MRN: -

Code: -

S.NO	Questions	Response category	
01	Age	_____ yrs.	
02	Sex	1. Male 2. Female	
03	Primary Admission diagnosis	1. Medical • Cardiovascular disease • Respiratory disease • Gastrointestinal • Renal • Neurological disease • Sepsis • Other, specify _____ 2. Surgical • General surgical • Trauma	
04	Is patient diabetic?	1. Yes 2. No	
05	Renal impairment	1. Yes 2. No	
06	Is patient on dialysis?	1. Yes 2. No	
07	Blood glucose level on admission	_____ mg/dl	

08	HgA1C test	1. Done 2. Not done If done, result _____ %	
09	Length of stay in the ICU	_____ days	
10	Blood glucose level during ICU stay	Use the table in the next page	
11	Is there record of BG level >140mg/dl during ICU stay	1. Yes 2. No	
12	HgA1C level if there is record of BG level >140mg/dl	1. Not done 2. Done _____ %	
13	Medications administered causing hyperglycemia	1. Corticosteroid 2. Vasopressors 3. Glucose containing fluids 4. None 5. Other _____	
14	Treatment of hyperglycemia	1. None 2. IV insulin infusion 3. SC insulin 4. Oral blood glucose lowering agent 5. No BG level $\geq$180mg/dl during ICU stay	
15	Outcome	1. Discharged improved 2. Died	

Blood glucose measurements during ICU stay

[illegible]

